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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : B29C 45/16

A1

(11) International Publication Number: WO 00/12284

(43) International Publication Date: 9 March 2000 (09.03.00)

(21) International Application Number: PCT/EP99/04852

(22) International Filing Date: 10 July 1999 (10.07.99)

(30) Priority Data:
PN98A000063 28 August 1998 (28.08.98) IT

(71) Applicant *(for all designated States except US)*: SIPA S.P.A. [IT/IT]; Via Caduti del Lavoro, 3, I-31029 Vittorio Veneto (IT).

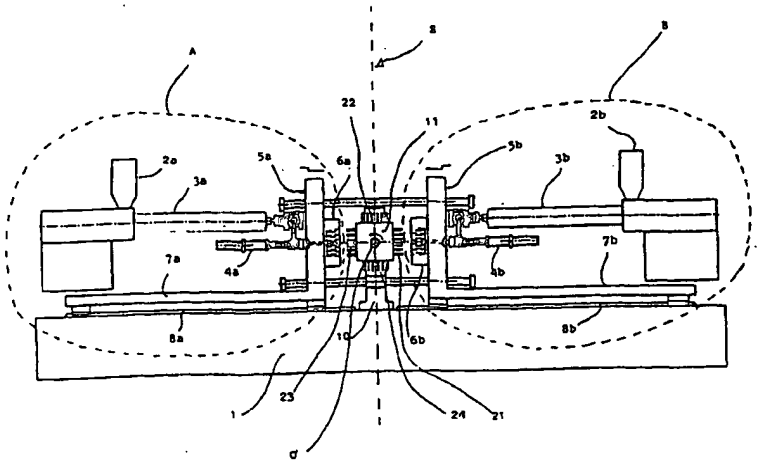
(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: DE NARDI, Ireneo [IT/IT]; Via della Vigna, 2/A, I-31016 Cordignano (IT). DA RIOL, Nicola [IT/IT]; Via Colombera, 25/2, I-33080 Porcia (IT).

(74) Agents: GIUGNI, Valter et al.; Propria, S.r.l., Via Mazzini, 13, I-33170 Pordenone (IT).

(81) Designated States: AU, BR, CN, JP, RU, SG, TR, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: IMPROVED APPARATUS AND METHOD FOR THE PRODUCTION OF MULTI-LAYER PREFORMS



(57) Abstract

Apparatus for the production of multi-layer plastic preforms, comprising a plurality of pairs of mutually coupling mould-halves forming a multiplicity of moulding cavities, a plurality of mutually associated extruders (3a, 3b) and/or injectors (4a, 4b) to the injection nozzle of which a respective mould-half (6a, 6b) is coupled permanently, wherein said extruders-injectors are adapted to inject different types of plastic resin into each multiplicity of cavities of each pair of mould-halves. There is also provided a support structure consisting of a table (11) rotating with respect to an axis (0) that is firmly associated with the assembly of said extruders-injectors, said rotary table (11) being provided on its outer edges with a plurality of mould-halves (21-24) adapted to successively couple with the mould-halves (6a, 6b) provided on said extruders-injectors, thereby forming temporarily associated pairs of mould-halves which are exclusively fed with resin and/or plastic substance processed in and flowing from the extrusion-injection means associated to the respective mould-half.

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IMPROVED APPARATUS AND METHOD FOR THE PRODUCTION OF MULTI-LAYER PREFORMS

DESCRIPTION

The present invention refers to an improved apparatus, and related method, for the production on a large-scale basis of multi-layer preforms made of thermoplastic material, in particular polyethylene terephtalate (PET) and polypropylene (PP), but possibly containing even other substances or synthetic compounds, adapted to be used in applications involving the production, by a blow-moulding process, of containers adapted to be filled with liquids that may even be at an elevated temperature and/or contain CO_2 (carbon dioxide) gas.

In particular, the present invention can be used in a most advantageous manner when the described apparatus is associated to a blow moulding plant in which the so produced preforms are directly converted into finished containers, ie. is integrated in a what is also known in the art as a single-stage plant, but can of course be effectively used also in connection with plants intended to only carry out the sole phase in which the multi-layer preforms are formed by injection moulding.

Techniques and machines for producing containers of the above cited kind are the subject of a number of developments and improvements that are generally aimed at obtaining, on the one side, increasingly improved, stronger containers that are capable of being used in connection with both hot-filled liquids and carbonated liquids, and, on the other side, production processes and related

apparatuses that are capable of producing said containers in an increasingly reliable, cost-effective, versatile manner, to higher quality standards, in an industrial context of very large-scale production.

These processes for the production of such types of containers are generally known to be able to be schematically divided into two basic typologies, ie. single-stage and two-stage processes.

The characteristics and synchronization of the processes falling within said two typologies are exhaustively described in the Italian patent applications nos. PN98A000042 and PN97A000068, as well as in the European patent application no. EP 0 768 165, filed by the same Applicant, to which reference should therefore be made.

Known in the art are also processes and apparatuses adapted to produce multi-layer preforms, ie. preforms that are produced by means of a sequence of phases in which respective subsequent layers of plastic materials are overinjected upon an initial layer which therefore also constitutes a kind of carrying structure for the layers that are subsequently overinjected upon it.

The purposes of and, in general, the technology concerning the processes and the apparatuses for producing multi-layer preforms are comprehensively described in the abundantly existing patent literature covering such a matter; of this literature, only a few among the most significant patents are cited below for convenient reference:
US 5,651,933 - US 5,433,766 - WO 9732708 - EP 0 367123 - US 5,674,448 - EP 0 722 887 - WO 9522451 - WO 9507219 - WO 9743104 - US 5,571,470 - US 4,868,026.

It is largely known from the prior art that the forming method for multi-layer preforms makes generally use of a plurality of injection-moulding and/or extrusion means associated to respective mould-halves, in which said means and said mould-halves are substantially linked to each other and stationary; further mould-halves, corresponding to the first ones, but moving, are caused to

alternately couple with the respective corresponding mould-halves in such a manner as to enable a first pair of mould-halves to produce the first layer of the preform. Immediately therefter, the latter is then removed, according to any of a number of known methods, from said first pair of mould-halves and transferred in a successive second pair of mould-halves where a second layer of resin is injected over said first layer that has just been formed in said first pair of mould-halves. The process goes then on in a similar manner for each possible successive layer required.

Such a method, although effective and well-proven for the desired purpose, implies however a multiplication of the injection/cooling times involved, since each single layer requires of course a specific injection/cooling time and, owing to said layers being overinjected in a sequence upon each other, such times unavoidably add to each other.

Also known in the art is a kind of apparatus and method in which the various pluralities of preforms in successive forming states (ie. having zero, one or more layers) are inserted in respective pairs of mould-halves that are clamped and injected with resin at the same time so as to form respective successive layers. With this method, which anyway proves quite complicated from a plant engineering and construction point of view, the result is obtaining of avoiding a multiplication of the total injection time of all successive layers, but the need arises for a clamping pressure to be produced which, owing to its having to ensure an adequate clamping of all pairs of mould-halves at the same time, is clearly greater by at least a twofold multiplication factor than the pressure that current plants are usually required to supply for forming traditional single-layer preform.

Such a huge increase in pressure, as well as in the resulting stresses and loads, makes it necessary for related plants to be provided which are unavoidably complex and cost-intensive as far as both their construction and utilization are concerned.

Based on the afore stated considerations, it therefore is a main purpose of the present invention to provide an apparatus and a method related to the stage embracing injection moulding and forming of multi-layer preforms adapted to be further processed in a production apparatus for conversion into hollow bodies, in particular bottles, in such a manner as to eliminate the afore mentioned drawbacks, with particular reference to the multiplication of the total preform forming time and the necessary structural and functional oversizing of the plant, so as to practically enable the overall productivity thereof to increase significantly, said apparatus and method being further capable of being easily implemented through the use of readily available, current techniques so as to prove reasonably low-cost, very reliable and preferably capable of being integrated with a possible stage provided downstream for blow moulding said preforms into said finished products.

This aim, along with further features of the present invention, is reached in an apparatus for injection moulding multi-layer preforms, which comprises at least a pair of mould-halves capable of coupling together, and possibly supported by respective platens, a plurality of cavities formed inside each said pair of mould-halves when the latter are clamped together, removal or ejection means for removing a respective train or cluster of preforms from each such pair of mould-halves, extrusion and injection means for melting, ie. plasticizing different compounds of plastic resins and injecting said different melted compounds of plastic resins or materials in their so obtained melted state into each one of said plurality of cavities of each such pair of mould-halves, one or more structures for supporting said extrusion and injection means, a further structure for supporting a positioning unit of a group of mould-halves having the same function, configuration and geometry, in which the above cited apparatus is characterized in that it is provided with a plurality of extrusion-injection means, to each one of which a respective mould-half is firmly associated, and that said further positioning structure is a rotary table capable of revolving with respect to an axis that is firmly joined with said support structures, said further structure being provided on its outer sides with a plurality of mould-halves adapted to couple in a sequence with the mould-halves associated to said extrusion-injection means so as to in this way obtain corresponding pairs of temporarily associated mould-halves, in which each

such pair of mould-halves is adapted to be only and exclusively fed with the resin and/or plastic substance so produced by and flowing from the extrusion-injection means associated to the respective mould-half.

The present invention may actually take body in determined parts and arrangements thereof, as well as particular operating conditions and manners, as substantially recited in the appended claims. Anyway, a preferred, although non-exclusive and non-limiting embodiment is described and illustrated below with reference to the accompanying drawings, in which:

- Figure 1 is a schematical longitudinal sectional view of a three-layer preform;

- Figure 2 is a schematical, basic view of an apparatus according to the present invention as shown in the open-mould operation state;

- Figures 3 and 4 are side views of the portion containing the moulds, under open-mould and closed-mould conditions, respectively, with an improvement in the construction thereof;

- Figure 5 is a view of the structure of the apparatus illustrated in Figure 2, provided however with the improvement shown in Figures 3 and 4;

- Figure 6 is a schematical symbolical view of a general embodiment of an apparatus according to the present invention.

The basic feature of the present invention lies in the fact that, as compared and in contrast to the arrangement provided in a traditional apparatus for forming multi-layer preforms, in which the hopper/extruder/injector assemblies are not only joined with each other, but also firmly associated to a same bedplate or frame that is usually resting on the floor, according to the present invention said same hopper/extruder/injector assemblies, while remaining joined to each other, are arranged so as to be able to slide in a reciprocating, ie. to-and-fro motion with respect to a rotary table revolving about a fixed axis.

Furthermore, according to the present invention also the moving mould-half, that opens and closes the complete mould provided with the cavities into which the molten resin is injected, is firmly associated to the sliding hopper/extruder/injector assembly.

When reference is made to Figure 2, an apparatus for forming two-layer preforms according to the present invention can be noticed to be illustrated there. Such an apparatus can further be noticed to comprise a common bedplate 1, two similar and specular assemblies comprised in the dashed lines "A" and "B", respectively and arranged symmetrically with respect to the symmetry plane of the apparatus indicated by the line "s".

The assembly "A" can be noticed to comprise a hopper 2a, an extruder 3a, an injector 4a, the mould-carrying table 5a, the mould-half 6a, and the slide 7a that is adapted to slide on a rail 8a associated to said common bedplate 1.

Similarly, the assembly "B" can be noticed to comprise a hopper 2b, an extruder 3b, an injector 4b, the mould-carrying table 5b, the mould-half 6b, and the slide 7b that is adapted to slide on a rail 8b associated to said common bedplate 1.

Devices, parts and materials used in said assemblies "A" and "B" are substantially the same, except of course for the fact that one of such assemblies is intended to process a first type of resin, eg. virgin resin , while the other one is intended process a different type of resin, eg. recycled plastics, as well as for the fact that, of course, the two mould-halves 6a and 6b are different owing to the second one having to be designed so as to be able to overinject the resin onto the preform produced by the first one. It will of course be further appreciated that also all accessory devices, controls and operating programmes or cycles must be adapted to said two different tasks and peculiarities. Such a circumstance, however, is readily understood by and fully within the implementation capability of all those skilled in the art.

Said assemblies are arranged on the respective slide 7a and 7b, firmly associated therewith, and are capable of sliding, on such respective slides, along respective rails 8a and 8b associated to said bedplate 1.

Between said mould-halves 6a and 6b there is provided a mould basis 10 which is linked with its base to said common bedplate 1 and is provided with a mould-carrying table 11 adapted to rotate with respect to an axis that is firmly joined to said bedplate 1, is comprised in said symmetry plane "s", and is indicated at "O" in the Figures.

Said mould-carrying table is provided with four sides, on each one of which there is arranged a plurality of mould-halves 21, 22, 23 and 24, which are indicated with the respective male-type elements in the Figure.

Upon having so defined and described the basic elements and features of the present invention, their working mode will now be described.

For reasons of greater convenience in the description, such a working mode is subdivided into four main phases. The first one of such phases is represented in Figure 2, where the mould-half 21 can be seen to be positioned at the right in front of the sliding mould-half 6b. In the second one of said phases the mould-half 21 is then rotated upwards, while in the third phase the same mould-half 21, by keeping rotating, is positioned to the left in front of the sliding mould-half 6a. Finally, in the fourth phase, said mould-half 21 is rotated downwards into the position which is shown to be occupied by the mould-half indicated with the reference numeral 24 in Figure 2.

In each one of these basic phases, corresponding to specific and univocal positions of the mould-carrying table 11, a number of operations are carried out, as described below in greater detail.

In the first phase, the assembly "B" is caused to move forwards until the respective mould-half 6b is brought into coupling with the mould-half 21 arranged in front of it; at the same time, the assembly "A" is similarly caused to move forwards until the respective mould-half 6a is brought into coupling with the mould-half-23. During this same first phase, the preforms, which have been completed in the manner that will be described in greater detail further on and are arranged on the lower mould-half 24, are removed from said mould-half and transferred to the subsequent operations with such means and methods as largely known in the art.

After said mould-halves 6a and 6b have so been coupled and clamped together, the due type of resin is injected in the required amount into each one of them; in other words, a first type of resin, which is usually a virgin resin, is injected into the mould-half 6b so as to practically form the first layer, or inner layer, of the preform. At the same time, a second type of resin is injected into the mould-half 6a over the preforms that are already arranged on the mould-half 23, as this will be better explained further on.

Upon the resins having so been injected into the respective moulds, the sliding mould-halves 6a and 6b are removed from the respective counter-moulds arranged on said rotary mould-carrying table and moved backwards into their initial position illustrated in Figure 2.

This completes the first phase, whereupon the second phase therefore begins, in which the rotary table is caused to rotate anti-clockwise by an angle of 90°, after which the same operations as illustrated above in connection with the first phase are carried out, so that, owing to the different position taken by the mould-carrying table, the preforms that had previously been so moulded in their first layer, are now displaced into the upper holding and conditioning position indicated by the mould-half 22, in which their outer surface is thermally conditioned, while the preforms that were placed in this holding position in the preceding phase, are now placed in the left-hand position, so that the second layer can be overinjected upon them, while the finished two-layer preforms are at the same time removed from the

lower mould in which are arranged the preforms that had previously been completed with their second layer by the assembly "A", the position of said lower mould being indicated by the mould-half carrying the reference numeral 24 in the Figure.

This procedure is repeated in each one of the afore cited four phases, in each one of which the same basic operations are practically carried out to clamp the mould-halves 6a and 6b , inject the respective layers of resin, hold the semi-finished (ie. featuring a single layer) preforms in the upper conditioning position, remove the finished preforms in the lower position, open said mould-halves, and rotate the rotary table 11 anti-clockwise by an angle of 90°. As it has been already pointed out, the basic operations performed are the same in each one of the four subsequent phases to which the four subsequent positions taken by the rotary moud-carrying table 11 actually correspond. What really distinguishes each such phase from the next one is the fact in each such phase a plurality of preforms are processed (ie. injected, cooled, overinjected and removed, respectively) which had been previously processed in accordance with the kind of treatment corresponding to the preceding position of the table.

What is substantially aimed at with such a procedure is to provide a transfer-type process in which an element that is due to undergo a series of operations is generally transferred in a sequence through a plurality of stationary work stations arranged successively and performing different tasks, so that all operations will have been carried out, ie. completed at the end of said sequence of transfer-processing steps. In the meantime, each station is continuously supplied with a successive element, so that no work station must actually wait for the element being processed to be completed before receiving and starting to process the next element . As a result, the cycle time will in this case be determined by the duration of the longest processing phase at a definite respective work station, or the so-called "pilot time"; in practice, work stations completing their cycle in a shorter time than such a pilot time are said to be working in a "hidden" or "masked" time since this time thereof has no influence at all on the total cycle time.

All this, however, is well known to those skilled in the art, so that no further description or explanation needs to be given here in this connection.

Going back to the preform moulding and forming process considered in this case, this actually constitutes a kind of transfer process in which the four work stations performing respective processing operations (first injection, conditioning, overinjection, removal) are not arranged along a straight path, but rather on a closed-loop one. As a result, the means that have to transfer the elements to be processed must follow such a closed-loop path; most advantageously, these means are of a rotary kind, as proposed by the present invention.

The invention itself may on the other hand be significantly improved if some advantageous improvements are adopted, some of which are cited below.

1) Mould clamping through the reaction of forces between the assemblies "A" and "B".

According to this solution, said assemblies are pressed against the respective mould-halves 6a and 6b in a manner that is neither autonomous nor independent, but are placed in a position that is opposite to said mould basis 10, while specific connecting and pulling means are provided between the respective mould-carrying tables 5a and 5b. In this way, by applying a pulling force to said means, the pressure to first bring a pair of mould-halves together and then clamp the so joined mould-halves is obtained directly and solely from the reaction to the clamping force of the opposite pair of mould-halves, since they are associated to the respective mould-carrying table.

The advantage of such a solution derives from a simplification in the overall construction, the automaticity in the synchronization of the motions of said assemblies "A" and "B" and, above all, the fact that no apparatus must be provided to specifically clamp the moulds, so that the same can be fully saved along with a corresponding reduction in the costs relating to the structure, the component parts and the energy usage thereof.

An advantageous manner in which such an improvement can be implemented consists in letting the mould-carrying tables 5a and 5b be connected to each other by at least a rod 30 that is integral with or firmly joined to one of said mould-carrying tables, eg. the table 5b as shown in Figures 3 and 4, and slidable with respect to the opposite mould-carrying table 5a which is in turn provided with traditional sliding and pressure means (eg. piston and cylinder, not shown) adapted to cause said table 5a to slide with respect to said rod 30 until said opposite mould-carrying table 5b brings the corresponding mould-half 6a into engaging the corresponding mould-half arranged on said rotary mould-carrying table 11.

2) A second improvement may derive from the fact that the mould-halves 21, 22, 23 and 24 are identical and of the male-type, so as to bring about a considerable simplification in the construction.

3) A third improvement, which is represented schematically in Figure 5, consists in adopting, in the intermediate position represented by the mould-half 22 positioned on the upper side, a further mould-half 33 that is coupled with the still incomplete preforms resulting from the first injection performed in the position of the mould-half 21.

Since preforms coming out of said mould-half are in fact in contact with the cavities of the first resing injection, their skin is rather cold; further to this, their temperature is further reduced during the free-air holding time beforee being again rotated and overinjected with the second layer.

This leads to a situation in which the surface temperature of the first layer of the preforms is too low for said layer to be able to amalgamate with and adhere without problems to the second layer being overinjected thereonto. In order to do away with such a drawback, said mould-half 33 is adopted, which is provided with a plurality of cavities 34 adapted to apply themselves on to the respective preforms coming from the mould-half 6a. Such a mould-half 33 has the task of heating and thermally conditioning, to an appropriate pre-selectable value, the surface of said

preforms before the overinjection of the second layer. This may be obtained with various techniques for innerly heating said mould-half, eg. by the circulation in said mould-half of an appropriately hot tempering medium under thermostatic control, incl. forced hot-air circulation, or by means of electrical resistance heating elements embedded in the body of said mould-half, or again through the use of externally wound etch-foil or ribbon-type surface heating elements.

If the fact is now considered that the above described apparatus and the method only refer to the production of two-layer preforms, it clearly ensues that such an apparatus and method cannot be used if preforms with three or more layers have to be produced. The main teaching thereof can however be advantageously used which actually consists in providing a central mould-carrying table 40 rotating about a fixed axis, along with a plurality of extrusion/injection assemblies 41, 42, 43 etc. provided with respective mould-halves arranged according to a substantially radial pattern around said central mould-carrying table 40, as this is illustrated symbolically in Figure 6 (top view).

The afore described moulding method and contrivances must of course be adapted to the new constructional configuration, but this is fully within the ability of anyone skilled in the art, since he will only have to provide an apparatus adopting the basic teachings illustrated above.

In particular, such an apparatus for the production of preforms involving more than two layers can achieve corresponding advantages in terms of increased productivity, although the non mutually opposing arrangement of the extrusion/injection assemblies may in this case prevent the advantage of a reduction in the force and energy needed for clamping the moulds through the use of the afore illustrated force reaction effect from being obtained.

CLAIMS

1. Apparatus for the production of multi-layer plastic preforms, comprising:

- at least two pairs (6a, 23; 6b, 21) of mutually coupling mould-halves that are possibly supported by respective mould-carrying tables (5a, 5b),

- a plurality of cavities provided inside each such pair of mould-halves when the latter are soclosed and clamped together,

- means adapted to remove a respective plurality of preforms from each such pair of mould-halves,

- extrusion means (3a, 3b) and injection means (4a, 4b) to first melt different components of resin or platic material and to inject the so obtained different components of resin or platic material in their molten state into each one of said cavities of each such pair of mould-halves.

- at least a bedplate (1) supporting said extrusion and injection means, characterized in that:

- each such extrusion-injection means (3a, 3b; 4a, 4b) is firmly associated to a respective mould-half (6a, 6b),

- there is provided a further structure adapted to support the remaining mould-halves (23, 21), which are adapted to be coupled with said respective mould-halves (6a, 6b) associated to said extrusion/injection means, and consisting of a rotary table (11) capable of rotating with respect to an axis (s) that is firmly joined to said bedplate (1), in which said structure carries said remaining mould-halves (23, 21) on its outer sides and is adapted to rotatably move into pre.determined successive positions in which a plurality of pairs of mould-halves

(6a, 23; 6b, 21; 6a, 21; 6b, 23) capable of being coupled together temporarily, each such pair being formed by mutually interchanged mould-halves,

- each such pair of mould-halves capable of being temporarily coupled is adapted to be solely fed with resin and/or plastic material processed by and flowing from the extrusion-injection means associated to the respective mould-half.

2. Apparatus according to claim 1, characterized in that each one of said extrusion-injection means (3a, 3b; 4a, 4b), along with the respective mould-half (6a, 6b), is provided with means of displacement with respect to said support bedplate (1) that are capable of moving it from an initial position towards said rotary table (11), so that said respective mould-halves (6a, 6b) are able to couple with corresponding mould-halves (32, 21) provided on said rotary table, as well as to separate again from each other when said respective extrusion-injection means are moved back into said initial position thereof..

3. Apparatus according to claim 2, characterized in that said rotary table (11) is firmly associated to a mould basis (10) attached to said bedplate (1).

4. Apparatus according to claim 2 or 3, characterized in that when said rotary table is moved into an arrangement in which any of such extrusion-injection means becomes capable of coupling the respective mould-half with a mould-half provided on said rotary table, also at least another mould-half provided externally with respect to said rotary table is then moved into a position in which it is capable of coupling with a half-mould associated to a respective other extrusion-injection means.

5. Apparatus according to claim 4, characterized in that said rotary tableis capable of being moved into at least four distinct positions, in which two such positions correspond to two mould-halves provided on said rotary table coupling with mould-halves of respective extrusion-injection means, and a third position in correspondence of which there are provided means for removing and unloading preforms from one of said mould-halves (24) provided on said rotary table.

6. Apparatus according to claim 4, characterized in that

- on said rotary table there are provided four distinct mould-halves (21, 22, 23, 24) that are arranged at a right angle with respect to each other,

- two of said mould-halves (21, 23) are positioned on opposite faces of said rotary table and are arranged so as to be capable of coupling with respective mould-halves (6a, 5a) of said extrusion-injection means, and a further mould-half (22) is arranged in an opposite position with respect to said mould-half (24) positioned in correspondence of said preform removal means.

7. Apparatus according to claim 5 or 6, characterized in that

- at least two of said extrusion-injection means are arranged in an opposite position with respect to said rotary table (11), and the force for clamping together a pair of mould-halves is obtained by the reaction to the clamping force of the opposite pair of mould-halves.

8. Apparatus according to any of the preceding claims 2 to 7, characterized in that

- the mould-halves associated to said extrusion-injection means, arranged in an opposite position with respect to each other, are connected by at least a means, preferably a rod (30) firmly joined to one of said mould-carrying tables (5b), but capable of sliding with respect to the opposite mould-carrying table (5a), in which said rod is provided with sliding and pressure-clamping means adapted to enable said opposite mould-carrying table (5a) to slide withy respect to said rod until the mould-halves provided on the respective mould-carrying tables are brought into engaging the corresponding mould-halves provided on said rotary table.

9. Apparatus according to claim 8, characterized in that said sliding and pressure-clamping means comprise a toggle member or, alternatively, a piston-and-cylinder member.

10. Apparatus according to any of the preceding claims, characterized in that the male-type mould-halves are arranged on said rotary table (11).

11. Apparatus according to any of the preceding claims, characterized in that there is provided aremoval position for said central rotary structure on which each mould-half applied on said rotary table is successively and selectively placed, appropriate means for removing the preforms from said mould-halves being provided in correspondence of such a position.

12. Method for forming multi-layer preforms of plastic material, comprising the phases in which:

- the inner layer of preforms of plastics with an open end portion, side walls and an opposite closed end portion is formed,

- a cavity is provided between two first injection-moulding mould-halves as defined by side walls, an open end portion adapted to accomodate an inner rod, which is comprised in one of said mould-halves, and a closed end portion with an injection gate passing therethrough,

- the plastic material comprising the inner plastic layer of the preform is inserted in said cavity of said injection-moulding mould-halves,

- the inner layer of the hardened preform is removed from said cavity and is inserted in a second cavity provided between two second injection moulding mould-halves as defined by side walls, an open end portion adapted to accomodate an inner rod and a closed end portion with an injection gate passing therethrough,

- a second layer of plastic material is overinjected upon the preform in said second injection moulding cavity,

characterized in that

- said second cavity is obtained by separating and moving away the first mould-half that does not comprise said inner rod, and replacing it with only one of said second mould-halves so that said second cavity is delimited by the first of said mould-halves comprising said inner rod, as well as by the second mould-half,

- after said first one of said mould-halves not comprising said inner rod having been so moved away, and before the same is replaced through the application of said second mould-half, the remaining mould-half of said first mould-halves, which comprises said inner rod, is rotated by at least a right angle with respect to a rotation axis that is orthogonal to the axis of said inner rod.

13. Method according to claim 12, characterized in that said first mould-half is rotated by half a round angle, and that in said second position thereof it is capable of being closed frontally by the coupling of an appropriate mould-half adapted to form a cavity for the overinjection of a seconf layer of preforms, wherein in this same position a further mould-half that is substantially similar to said first mould-half is rotated into such a position as to be capable of coupling frontally with said first mould-half that is not provided with said inner rod.

14. Method according to claim 13, characterized in that it comprises the phases of:

- providing a plurality of substantially identical mould-halves arranged along the outer edges of a rotary table adapted to stop at a corresponding plurality of pre-determinable positions,
- providing a corresponding plurality of mould-halves, at least two of which, connected to respective plastic extrusion-injection means, are arranged in a relation of frontal correspondence to respective at least two of said mould-halves on the rotary table when the latter stops at one of said pre-determinable positions,
- closing said corresponding mould-halves with a translatory motion of said mould-halves connected to respective extrusion-injection means, thereby forming said cavities,
- injecting the resin masses required to form the respective preform layer into the so obtained cavities in an essentially synchronous manner.

15. Method according to claim 14, characterized in that:

- upon completion of said injection phase, each mould-half connected to the related extrusion-injection means is opened with a contrary motion with respect to the closing motion,
- said rotary table is rotated in such a direction and by such an angle as to enable at least two mould-halves arranged thereon to be positioned in front of respective mould-halves connected to respective extrusion-injection means.

16. Method according to claim 14, 15 or 16, characterized in that said operations for closing and opening said pairs of mould-halves and injecting plastics into the respective cavities are carried out in an essentially synchronous manner for each type of operation.

17. Method according to any preceding claim from 12 on, characterized in that the force needed to close and clamp two pairs of moulds located at the opposite sides of said rotary table is obtained from the mutual reaction of the closing and clamping force of each mould.

18. Apparatus according to claim 17, characterized in that the phase in which the preforms are removed from the successive mould-halves is carried out as the injection and conditioning phase is being performed on at least another pair of mould-halves.

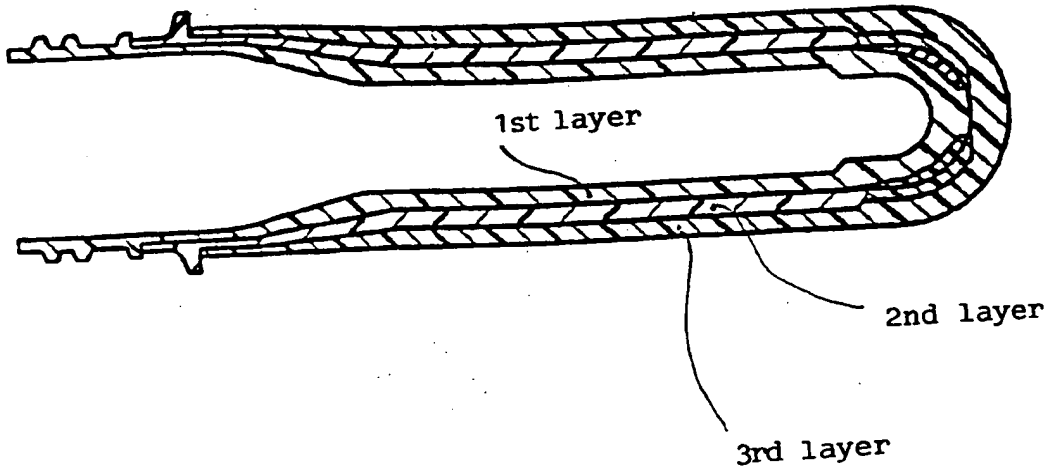


FIG. 1

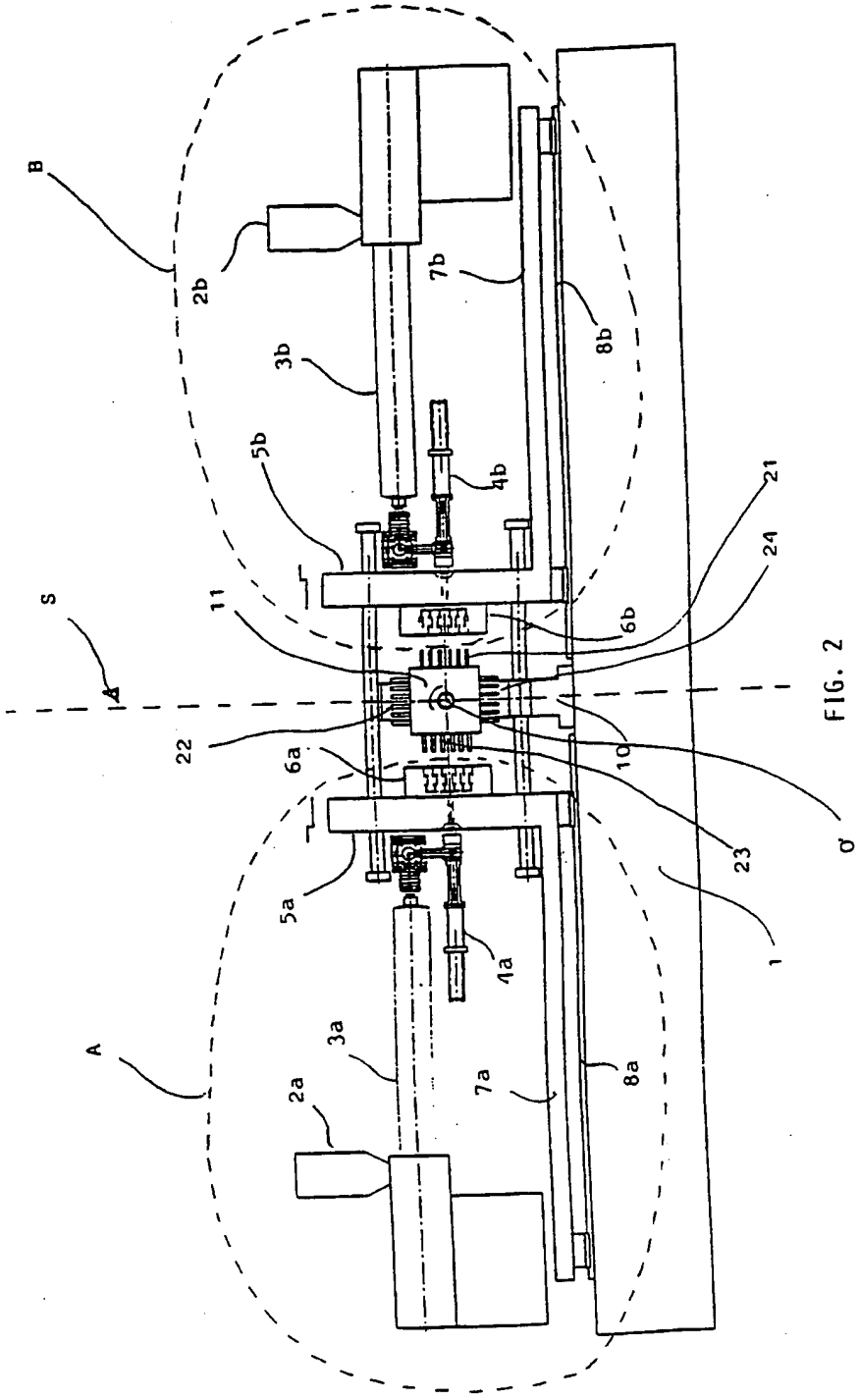


FIG. 2

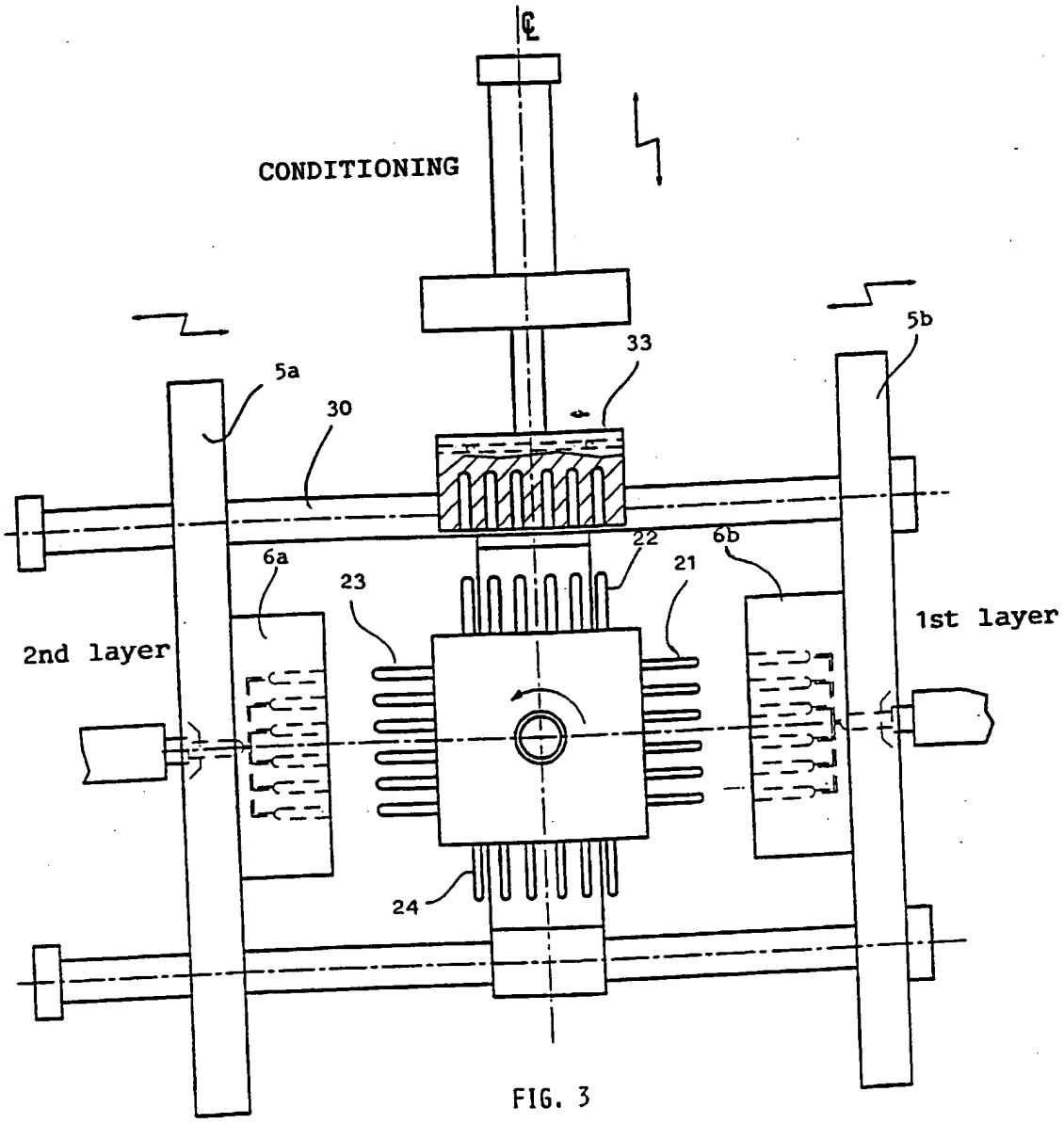
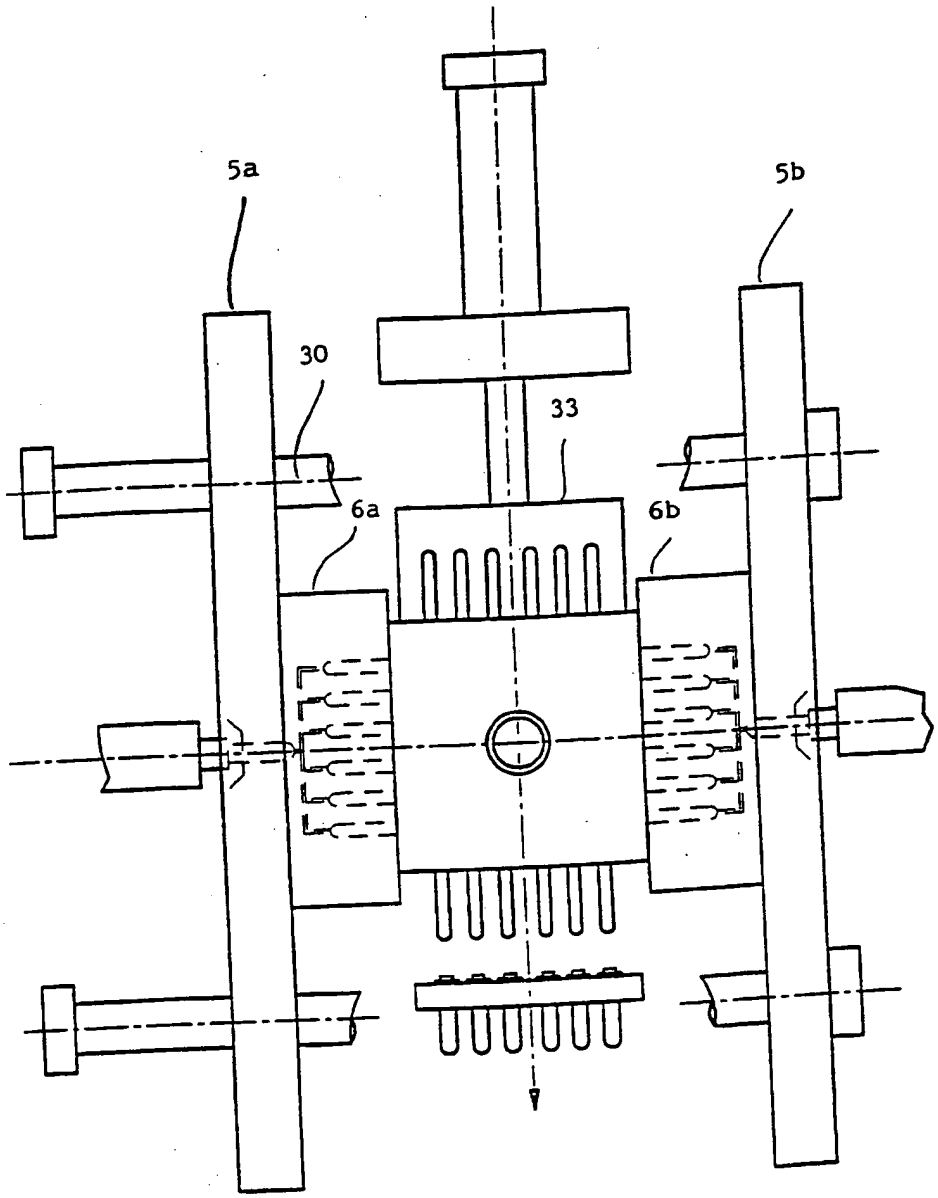


FIG. 3



PREFORM UNLOADING

FIG. 4

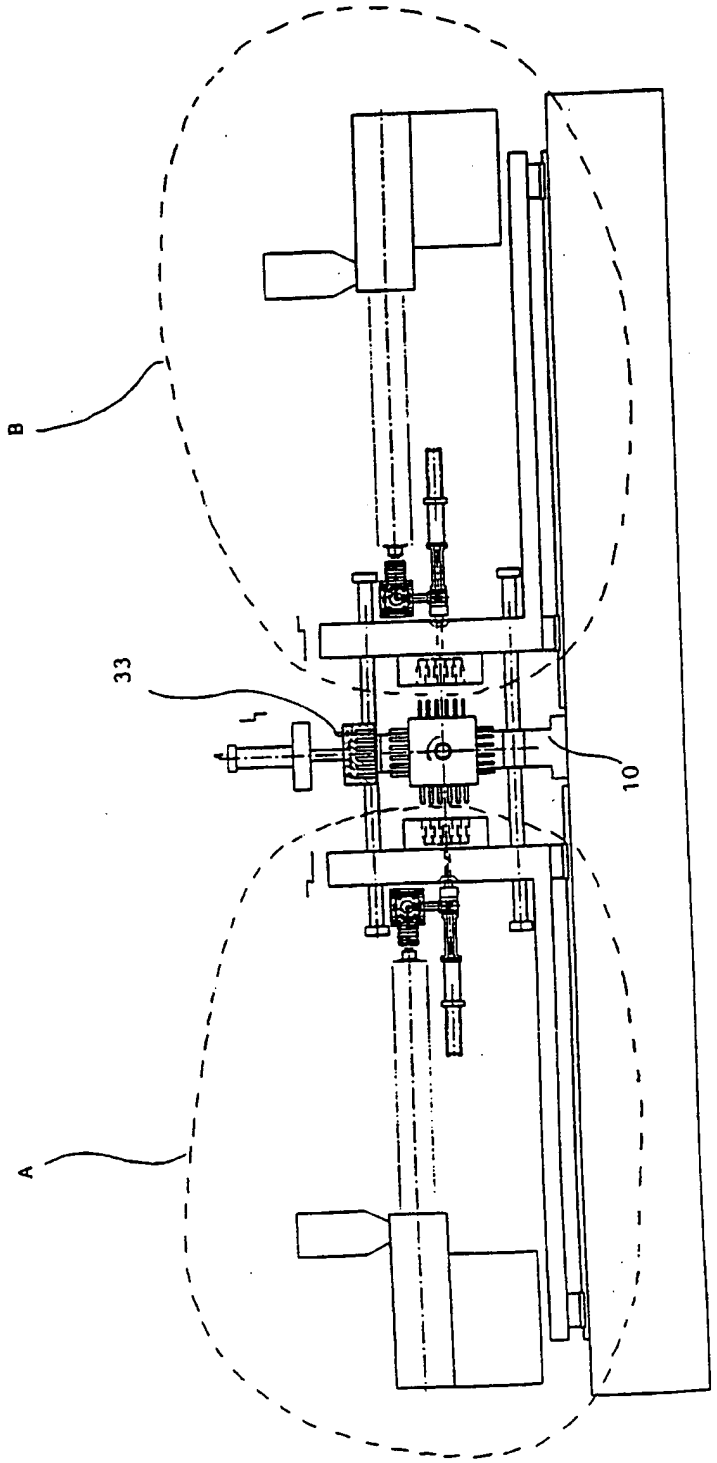


FIG. 5

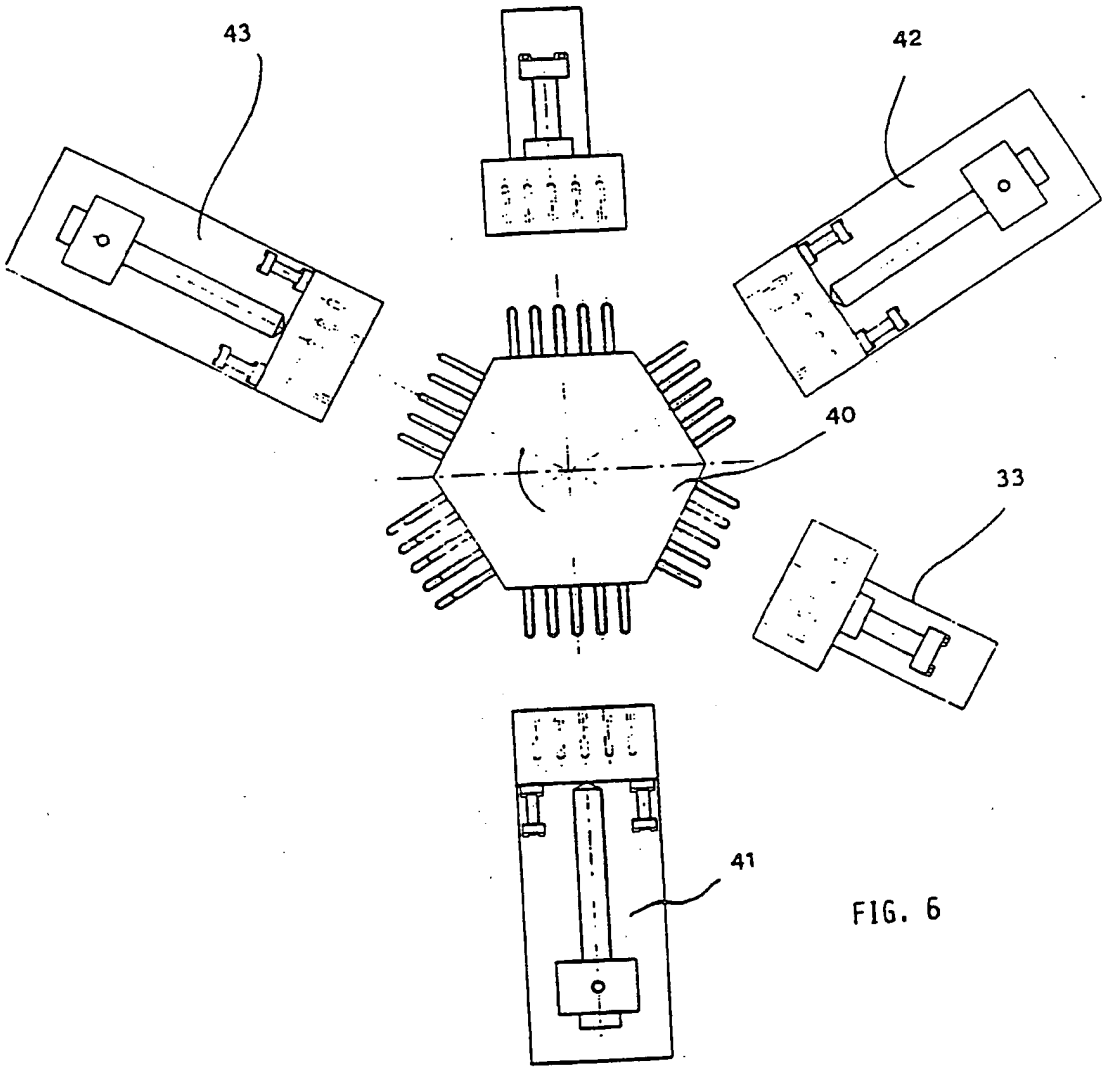


FIG. 6

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B29C45/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	EP 0 794 045 A (HUSKY INJECTION MOLDING SYSTEMS) 10 September 1997 (1997-09-10) column 14, line 40 -column 16, line 41; figures 20-22	1,4-6, 10-16,18 2,3,7-9, 17
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☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
25 October 1999	03/11/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Bollen, J

Form PCT/ISA/210 (second sheet) (July 1992)

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